Level: master

Course title: Condensed matter theory

Status: obligatory

ECTS: 7

Requirements: Phase transition theory

Learning objectives

Obtaining the basic knowledge of theoretical solid state physics **–** electron in the periodic crystal lattice potential, electron bands, interacting electron gas, Hartree – Fock approximation, Random Phase approximation, dielectric function, insulators, crystal lattice vibrations – phonons, electron – phonon interaction, superconductivity, magnetism theory.

Learning outcomes

After taking the course, students should have developed:

General abilities: basic knowledge in this field, following the literature, analysis of various solutions and the choice of the most adequate solution, application in practice and other subjects, creativity.

Subject-specific abilities: knowledge of the basic concepts and problems related to solid state, successful application of modern theoretical methods to physical situations of interest.

Syllabus

Theoretical instruction

Translational symmetry, inverse lattice. Second quantization. Bloch's theorem. Elementary excitations. An electron in the periodic potential of the crystal lattice; electron zones; interacting electron gas; Hartree-Fock approximation; RPA (Random Phase Approximation); dielectric function; insulators; Magnetic properties of the electron gas – Pauli paramagentism, diamagnetism of conducting electrons. Wannier and Frenkel excitons. Metal – insulator transition. Hubbard model (band and atomic limit). Tensor of magnetic susceptibility in HF and RPA. Concepts about the magnetism in metals. Ferromagnetic and antiferromagnetic ordering, spin density waves.

Harmonic displacement, phonons electron-phonon interaction; superconductivity

Practical instruction

Problem solving, homework.

Weekly teaching load				Other:
Lectures: 3	Exercises: 3	Other forms of teaching:	Student research:	